the Pulse AOT&LANSCE

May 2014
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INSIDE

Los Alamos NATIONAL LABORATORY EST. 1943

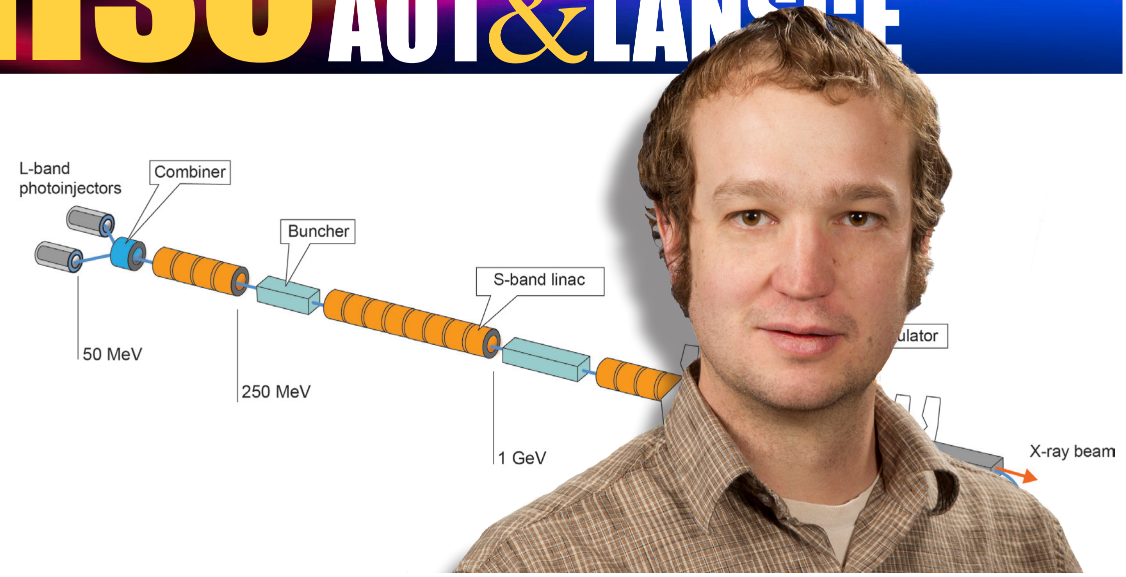

Photo by Richard Robinson, IRM-CAS

Quinn Marksteiner

Advancing accelerator-based technology for divergent applications

By Diana Del Mauro, ADEPS Communications

Quinn Marksteiner is putting his diverse experimental and theoretical skills to work helping to design the light source at the heart of MaRIE, the Laboratory's proposed flagship experiental facility.

Background: pre-conceptual layout of the world's first very hard (42-KeV) x-ray free electron laser and 12-GeV electron linac.

> *"For better or worse, I've had a broader variety of things I've worked on than most people."*

Quinn Marksteiner is a versatile physicist who seems to make a mark no matter what experimental or computational project he dives into. "Everything he touches he does well with," said his boss Steve Russell, acting group leader of High Power Electrodynamics (AOT-HPE).

Take, for example, the Superluminal RADAR System, a radio transmitter that offers superior transmission over long distances as compared to conventional antennas. After garnering an award and patents, the technology is now sought by an international telecommunications company. "We built the antennae, and it worked," Marksteiner said. The antennae's novelty lies in a radio wave source that moves faster than light, releasing tight bundles of electromagnetic radiation that are fundamentally different than typical sources. Marksteiner developed the concept behind the circuits plus wrote the software to control the machine and run experiments with it.

For another project, Marksteiner made significant contributions in developing LANL's capability in the fabrication and characterization of an important class of materials known as ferroelectrics. These materials can be used in a wide range of applications, including capacitors, transducers, and electrically tunable RF control devices. Marksteiner developed a diagnostic tool that characterizes the high-frequency properties of these ceramic materials. Using this probe, he worked closely with a materials scientist to develop ferroelectric materials that are high quality and innovative.

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“Thanks to you, DOE-VPP recommended that the Laboratory receive VPP Star Status.”

Alex

From Alex’s desk . . .

Colleagues,

The Linac Risk Mitigation continues to make a great deal of progress. Since the end of the last run cycle a lot of complex activities have been taking place, with excellent levels of worker involvement, coordination, and management participation. Safety continues to be an integral part of all activities, and the results are no less than impressive. Depicted here, from the water system controls to Model-2 initial testing, work is progressing as planned and on schedule.

Beam production is scheduled to resume the first week of October. The WNR facility will be operating as usual, with six flight paths at Target-4, three flight paths at the Lujan Center, and Target-2 (Blue Room). The proposal call for nuclear science experiments and semiconductor irradiations (ICE House, ICE-II) has been issued, with a submittal deadline of Monday, June 2. For additional information, please contact Tanya Herrera (Nuclear Science User Office administrator) at tanyah@lanl.gov. As well, the proton radiography proposal call was issued and proposals have been reviewed. Proposal ranking for the upcoming run cycle is in process.

We are disappointed, however, by the decision of the U.S. Department of Energy, Office of Basic Energy Sciences (BES), to cease its operational support of the Lujan Neutron Scattering Center in fiscal year 2015. For the past two decades, the Lujan Center has been operated through a partnership between the NNSA and BES. LANL, the NNSA, and the other research sponsors are assessing the impact of BES’s decision on Lujan Center FY15 operations and we are keeping Lujan Center users informed on this developing situation and the path forward. The Lujan Center has a distinguished record of innovation and contribution to our nation’s neutron scattering capability and a significant record of accomplishment in executing research of great importance to U.S. scientific competitiveness and national security.

Water cooling, coax, and controls connections are complete.

In coordination with the TA-53 WSST, we are about to issue the TA-53 Safety Implementation Plan (SIP). The TA-53 SIP will focus on two main goals:

- Goal-1: Provide Timely Feedback and Closure of Issues to Employee Requests and Suggestions. This will be done in fully coordination and cooperation through the WSST. WSST will track concerns and suggestions and report back.
- Goal-2: Peer Walkarounds. The WSST-led Solutions Team will be a key approach to implementing this goal. This is an important step towards getting us all involved with the safety aspects of our daily activities. Your participation is indeed paramount. The TA-53 WSST monthly meeting is held the second Monday of each month at 1:30 p.m. in the LEDA conference room. You are welcome to attend and actively participate.

A view of Module 2 controls initial testing in progress.

On that note, let me also take the opportunity to thank you all for engaging and assisting with preparations for the Voluntary Protection Program (VPP) follow-up team visit. As you know, TA-53 was an integral part of the recent assessment by the VPP team. Thanks to you, DOE-VPP recommended that the Laboratory receive VPP Star Status. If approved, keeping VPP star status will deserve continuing attention and our engagement at TA-53 is no less than essential.

LANSCE Deputy Division Leader Alex H. Lacerda

Marksteiner cont.

According to Russell, Marksteiner catches on quickly, is creative, and has sharp instincts about physics. He arrived at the Los Alamos Neutron Science Center, which has one of the nation's most powerful proton linear accelerators, as a postdoctoral researcher with a PhD in plasma physics from Columbia University and a hands-on sensibility for building circuits and designing experiments.

With opportunities to develop his aptitude for computational and theoretical research, Marksteiner, who became a staff member in 2009, has branched out into those areas of study, gaining him a role in more complex projects. "For better or worse, I've had a broader variety of things I've worked on than most people," Marksteiner said.

Ultimately, Marksteiner said he hopes to specialize in beam physics. In his latest project he is figuring out how to make a light source according to specifications for the Laboratory's proposed MaRIE (Matter-Radiation Interactions in Extremes) experimental facility, which will allow scientists to take in situ, transient measurements of materials in extreme environments. "That project is fun because it's a really big project and you get to work with a lot of bright, interesting people," he said. Quinn runs numerical simulations of the light source—a high-energy x-ray free-electron laser (XFEL) that produces intense monochromatic light—as it travels through the accelerator to a virtual test sample. "It's still a work in progress, but we've come up with some novel schemes," he said.

Marksteiner admitted that always learning something new can be exhausting. For renewal, he gets outdoors with his children and plays saxophone with local bands.

Quinn Marksteiner's Favorite Experiment

What: Design and simulation of the MaRIE XFEL

When: 2010-present

Where: This was theory and simulation work, so it was done in my office at LANSCE.

Who: I work with a large group of people on this project. The people I worked with most closely on this specific example are Bruce Carlsten (Accelerator Operations & Technology, AOT-DO), and Petr Anisimov, Nikolai Yampolsky, and John Lewellen (all AOT-HPE).

Why: We are doing initial design work on the planned MaRIE x-ray free-electron laser (XFEL). The XFEL is driven by an electron beam. For the XFEL to work properly, the electron beam needs to be very energetic (12 GeV), but still very cool (i.e, all the electrons are traveling in the same direction with the same energy). This is difficult because of wake effects where the electron beam heats up through interaction with itself.

How: We model the MaRIE XFEL with numerical tools and analytical theory. The numerical tools we use include the beam physics code Elegant and the FEL code GENESIS. Eventually we hope to test our ideas with experiments.

The a-ha moment: We developed a method for simultaneously suppressing two important wake effects (CSR and resistive pipe wakes) by compressing the electron beam into a series of smaller beams, instead of one large beam. The smaller electron beams can be created by using existing laser technology. If this works, it will significantly reduce the risk of the MaRIE XFEL. We are still carefully studying this idea and comparing it with the conventional design of an XFEL.

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Published by the Experimental Physical Sciences Directorate

To submit news items or for more information, contact Karen Kippen, ADEPS Communications, at 505-606-1822, or kkippen@lanl.gov. For past issues, see lansce.lanl.gov/news/pulse.shtml.

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Celebrating service

Congratulations to the following LANSCE and AOT employees celebrating service anniversaries recently:

Felix Olivas, AOT-MDE .... 40 years
Stephen Morgan, AOT-OPS .... 25 years
Bill Waganaar, LANSCE-NS .... 25 years
John Chamberlin, AOT-MDE .... 15 years
Fredrik Tovesson, LANSCE-NS .... 10 years

Measuring the neutron capture cross section of ^{239}Pu

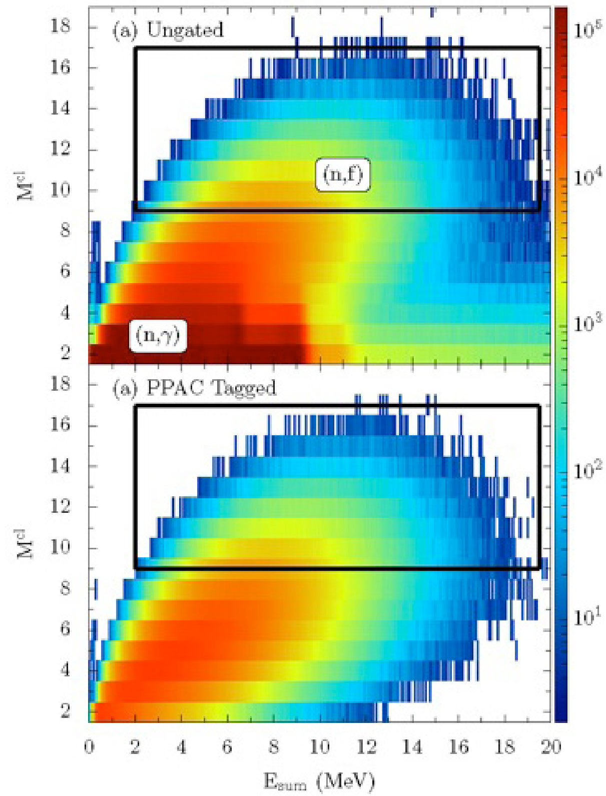
The ^{239}Pu neutron capture cross section is an important factor used in many reactor calculations, as well as in weapons-related calculations. The Advanced Reactor Concept program, a DOE program considering the next generation of reactor designs, identified a need for precise knowledge of the cross section above 2 keV. This cross section has now been measured by a collaboration between members of Los Alamos's Nuclear Science (LANSCE-NS) and Nuclear and Radiochemistry (C-NR) groups, and Lawrence Livermore National Laboratory.

The cross-section measurement is challenging due to the large background of gamma-rays emitted from fission events following neutron capture. DANCE (Detector for Advanced Neutron Capture Experiments) provides a novel method for obtaining these cross sections in light of the constraints for fissile isotopes. A thin ^{239}Pu target mounted inside a charged particle detector is used to simultaneously characterize the prompt fission spectrum and measure the capture cross section, utilizing the difference between the two dimensional plots of multiplicity (M^{cl}) versus total detected gamma-ray energy (E_{sum}) (see figure). The fission contribution to the 2D plot is determined using coincidences with a parallel plate avalanche counter (PPAC) that detects the fission fragments. The difference between the measured 2D plot without a coincidence requirement and the plot in coincidence with the PPAC is due to the (n,g) capture reaction.

Results of the ^{239}Pu capture-to-fission ratio α and the $^{239}Pu(n,\gamma)$ cross section deduced for the neutron energy region 10 eV to 1 keV have been determined. This measurement largely confirms the current evaluation, but differences in the individual resonances strengths are observed in several cases. The present work represents a significant advancement in experimental technique over prior work, and the detailed background suppression and subtraction methods can be observed to result in a marked improvement for weak signal-to-noise regions. The signature of fission events in DANCE has been explored via measurements from gamma rays emitted in coincidence with a PPAC signal triggered by a fission fragment, which allows for possible future work to extend the measurement to higher neutron energies.

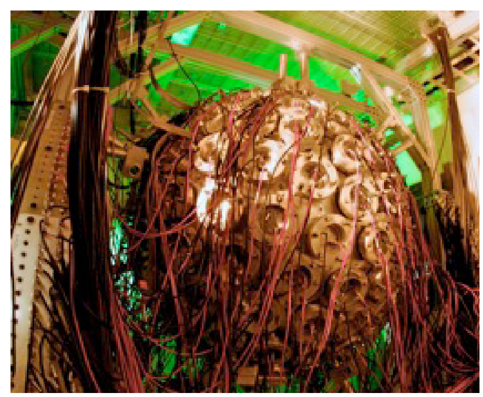
The work, funded by NNSA-NN, supports the Laboratory's stockpile stewardship mission and nuclear and particle futures science pillar. Los Alamos participants include Shea Mosby (LANSCE-NS), Todd Bredeweg (C-NR), Andrii Chyzh and Aaron Couture (both LANSCE-NS), Marian Jandel (C-NR), John O'Donnell and John Ullman (both LANSCE-NS).

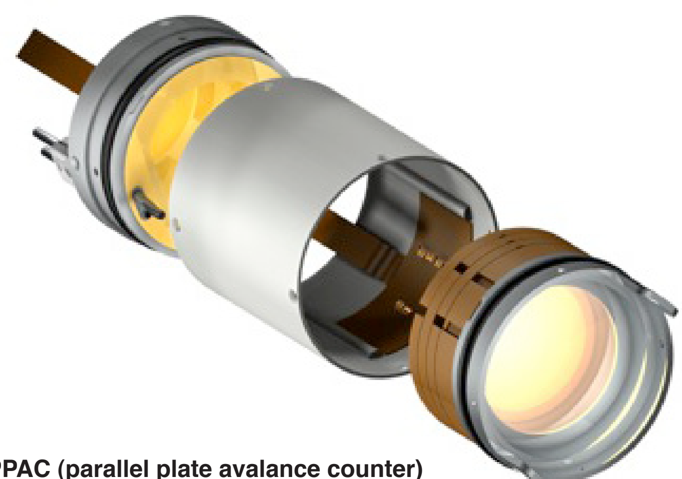
Technical contact: Shea Mosby, LANSCE-NS



M^{cl} vs. E_{sum} for ungated (a) and PPAC coincidence (b). The box defines a region where only fission contributes to the spectrum, and is used to determine the PPAC efficiency.

DANCE (Detector for Advanced Neutron Capture Experiments)





PPAC (parallel plate avalance counter)

Fitzsimmons elected NSSA Fellow

Lujan Center researcher recognized "for many important contributions to the study of interfacial and thin-film magnetism using polarized neutron reflectometry."

Michael Fitzsimmons (Lujan Center, LANSCE-LC) is a 2014 Neutron Scattering Society of America (NSSA) Fellow. Through the NSSA Fellowship Program, the NSSA recognizes members who have made significant contributions to the neutron scattering community in North America through original research and publication, innovative contributions in the application of neutron scattering, contributions to the promotion or development of neutron scattering, or service and participation in the activities of the NSSA or neutron community.

The Society recognized Fitzsimmons "for many important contributions to the study of interfacial and thin-film magnetism using polarized neutron reflectometry."

Fitzsimmons is the Asterix instrument scientist at the Lujan Neutron Scattering Center. In 2001 he garnered a Distinguished Performance Award for single-handedly designing and building Asterix, a polarized neutron reflectometer/ diffractometer. The instrument incorporates novel neutron optical concepts to polarize a large, pulsed neutron beam, something the neutron-scattering community had considered difficult to accomplish. Asterix supports studies of the magnetism of thin films and magnetic nanostructures and has produced interesting results related to the magnetic structure of new spintronics devices.

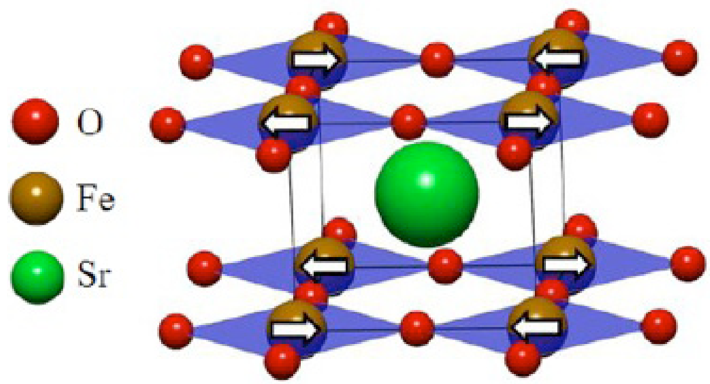
After receiving his doctorate in materials science and engineering from Cornell University, Fitzsimmons performed research in Munich, Germany as a Fulbright Jr. Research Fellow. He later joined Los Alamos as a Postdoctoral Fellow and became a staff member in 1993. In 2006, Fitzsimmons was named an American Physical Society Fellow for achievements using polarized neutron reflectometry. He also serves on the board of directors for the Materials Research Society as treasurer.

Formed in 1992, the Neutron Scattering Society of America has more than 1,000 members from 26 countries. No more than one-half of one percent of members are honored as fellows annually through election by the fellowship committee.

Unusual suppression of magnetic coupling in a low-dimensional iron-based oxide

Using neutron diffraction at the Lujan Neutron Scattering Center, Laboratory researchers and University of Virginia collaborators observed how a structural instability in $SrFeO_2$, a new, low-dimensional magnet, leads to the break down of its very robust magnetism. Their analysis of the cause of the magnetic coupling suppression sheds light into a strong spin-to-lattice coupling mechanism involving local fluctuations at the atomic scale. Similar local modes to the ones present in this system have been described in other superconductors, suggesting that they are a rather common feature in strongly correlated electron systems.

Their results strongly suggest that local structure instability correlates with the magnetism where the distortions suppress orbital overlap. The structure's complexity, revealed by the work, also suggests that any theory based upon the average crystallographic structure without local distortion may be unrealistic.



The crystal structure of $SrFeO_2$ in the tetragonal P4/*mmm* symmetry.

Low-dimensional magnetic lattices are fertile ground for unconventional properties. $SrFeO_2$ is an insulating antiferromagnet with a remarkably high transition temperature in spite of its quasi-two-dimensional crystal structure, very similar to La_2CuO_4, the parent phase of the cuprate superconductors. The magnetic exchange coupling is, however, very sensitive to a local mode involving transverse displacements of O and Fe, resulting in zigzag patterns of distortion. The buckling driven by rising temperatures is enhanced just as the Fe magnetic moment is reduced, implying a strong spin-lattice coupling. The researchers suggest that the undulations lead to orbital disorder by distorting the three possible paths to exchange interactions.

This work benefited from the use of the High Intensity Powder Diffractometer at the Lujan Neutron Scattering Center, funded by DOE Office of Basic Energy Sciences. The work

continued on next page

Unusual cont.

at the University of Virginia is also supported by the DOE Office of Basic Energy Sciences. The research supports the Lab's Energy Security mission and Materials for the Future Pillar. Reference: "Suppression of Magnetic Coupling by in-Plane Buckling in $SrFeO_2$," Kazumasa Horigane and Despina Louca (University of Virginia, Charlottesville) and Anna Llobet (LANSCE-LC), accepted for publication in *Physical Review Letters.*

Technical contact: Anna Llobet

LANSCE studies of radiation damage effects in new technologies for the Large Hadron Collider

The LANSCE proton beam is providing critical support for the ongoing development of new radiation-tolerant technologies to detect particles at the Large Hadron Collider (LHC) at CERN. This has included technologies that, using LANSCE proton beam irradiations, aided sensor design, signal amplification, and advanced material development that enabled the 2012 discovery of the Higgs boson particle. Now, the multinational team of physicists and engineers from more than 20 institutes, led by the University of New Mexico Collider Physics group, are using LANSCE to aid the upgrade of the LHC collider and detectors. The collider upgrades increase both its energy and its luminosity in order to probe earlier cosmological epochs and rarer processes, respectively.

Being finalized this year, the first upgrade (to center of mass energy 14 TeV and luminosity 10^{34} cm^{-2} s^{-1}) already incorporates several technologies perfected through UNM work at LANSCE. To be completed by about 2017, the second upgrade will raise the luminosity to three times design. By about 2020, a third upgrade will bring the luminosity to 10^{35} cm^{-2} s^{-1} (10 times design). Finally, circa 2030, a fourth upgrade will double the energy of each beam.

Most at risk of damage through lattice displacement is the detector that makes the most precise and sensitive measurements of the rarest species: the silicon vertex detector covering radii less than 20 centimeters from the beam. In that region, pions, with a spectrum peaking at 2 GeV, are the primary source of damage.

No test facility exists with high intensity 2-GeV pions. Fortuitously, however, the non-ionizing energy loss displacement damage characteristic of those pions is nearly identical to that of 800-MeV protons (see figure). Thus the LANSCE facility is at the heart of the effort to develop the detectors for the upgraded LHC. The UNM team has undertaken two irradiations, of 3-4 days each in the Blue Room every year since 2007. More than 24 publications have resulted from the UNM/LANSCE program, and the effort has contributed to the training of 12 graduate and undergraduate students and three postdoctoral fellows. The U.S. DOE High Energy Physics program funds this work that relies on the special capabilities of the LANSCE accelerator facility. This supports the Laboratory's mission to perform world-class science while training the next generation of scientists, and ties into the Nuclear and Particle Futures science pillar.

Technical contacts: Ron Nelson, Steve Wender

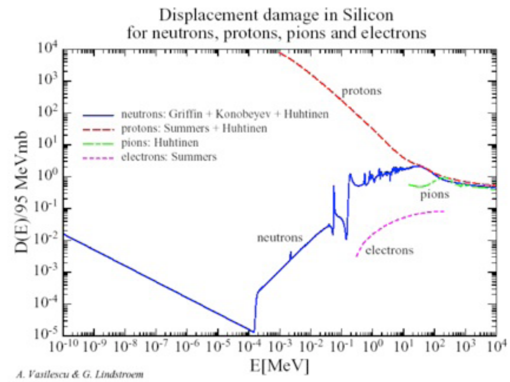


Figure: Displacement damage in silicon for neutrons, protons, pions, and electrons. In the energy regime relevant to the interaction region of the LHC, the effect of the dominant species, 2 GeV pions, is well modeled by the LANSCE 800 MeV protons.

UNM Research Electrical Engineer Martin Hoeferkamp installing semiconductor test boards for placement in the LANSCE proton beam

UNM undergraduate student Cristhian Carrillo (who was selected to report his LANSCE work at the Posters on the Hill conference in Washington DC) [center]; UNM graduate student Rui Wang [left]; and UNM graduate student Jessica Metcalfe [right] stand next to the stacked sample assembly in the Blue Room at LANSCE.

HeadsUP! ADEPS Environmental Action Plan for FY14

Environmental management will always be an ongoing effort. Our 2014 Environmental Action Plan addresses our impact on the environment, and outlines steps we can take to reduce our impact and decrease the potential for and severity of any environmental damage.

In keeping with the three-pronged approach established in the recent past, we have focused upon three objectives: Clean the Past; Control the Present; and Create a Sustainable Future. These objectives parallel the LANL institutional objectives, with the targets fine-tuned to fit our Directorate's needs.

Clean the Past: Reduce Environmental Risks from Historical Operations, Legacy and Excess Materials, and Other Conditions Associated with Activities No Longer a Part of Current Operations.

Target 1: Focused inventory on out-of-date peroxide formers to ensure proper testing and potential disposal pathways.
Target 2: Reduce ADEPS surplus equipment, salvaging or recycling wherever appropriate; inventory and work to minimize use of transportainer storage units; reduce total volume of chemical containers; properly disposition unwanted/unneeded office and lab items; properly disposition legacy records and documents.

- Action 1: Reduce, Salvage and Recycle
- Action 2: Transportainer Inventory, Clean-out, and Removal
- Action 3: MST Clean-out of 03-35 (Contingent on available funding)
- Action 4: MST Clean-out of 03-169 (Contingent on available funding)

Control the Present: Control and Reduce Environmental Risks from Current, Ongoing Operations, Missions, and Work Scope.

Target 1: Managers will conduct at least one environmentally-focused MOV in each quarter
Target 2: Perform annual chemical inventories (90% of ChemLog entries inventoried)
Target 3: Communicate environmental objectives to the Directorate
Note: all three targets are assessed on an annual basis.

Create a Sustainable Future: Reduce or Eliminate the Use of SF6 Green House Gas (GHG) by Recycle/Reuse or Replacement Activities.

Target 1: SF6 reduction, elimination, and/or reclamation of this egregious GHG is an institutional environmental goal via the LANL SSP (Site Sustainability Plan).

We need you to turn off lights in offices, conference rooms, hallways, and labs when not in use. Get that leaking faucet/toilet/urinal fixed (contact your Facilities Coordinator). Turn off computer peripherals when not in use. Alter your purchasing habits–Purchase GREEN. Use the blue and green recycling bins. Share chemicals, minimize chemical inventories, purchase safer alternatives, recycle and dispose properly. Salvage all unnecessary or unused (and not needed) equipment. Nominate a deserving colleague for a P2 Award!!

Document, record, and report all significant environmental actions that you take that positively affect the environment. Remember, if it's not recorded, it didn't happen. Please send your environmental action updates to your Division's EAP contact (MPA: Susie Duran at susiew@lanl.gov; MST: Jim Coy at jcoy@lanl.gov; LANSCE: Frances Aull at aull@lanl.gov; P: Steve Glick at sglick@lanl.gov). This will ensure that our Directorate continues to get the recognition it deserves for our environmental efforts.

The plan in greater detail can be found at hsrasweb.lanl.gov/emsdb/print_plan.asp?id=351.


Spring snow, White Rock Canyon

LA-UR-14-23007

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Title: AOT & LANSCE The Pulse May 2014

Author(s): Kippen, Karen E.

Intended for: Newsletter
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Issued: 2014-04-29